

Similarities of Math and Sci Insights

Similar

Compare: definition of circle; Galileo on free fall

Circle: we considered cart-wheel in its immanent intelligibility
 why is this a circle -- ruled out of consideration materials,
 purpose, wheelwrights, tools used by ww

Galileo: uninterested in final cause of x falling, difference
 in materials that fall, agents that produce fall

Equality of spokes

Galileo: correlation of distance fallen and time of fall, $s = \frac{1}{2}gt^2$
 series of measurements, tabulate on graph, draw curve, determine
 formula that gives best fit

Do circles exist

Do bodies fall with constant acceleration. In a vacuum. But
 a ~~vacuum~~ perfect vacuum does not exist in lab. The hearer
 we approach, the closer to constant acc /suspicion
 /provided imagination beyond

Dissimilar

Circle: armchair -- data continuous -- necessity impossibility

Fall: field work -- data discontinuous -- just possibility

Verification necessary -- verification does not prove

Definition backward influence on imagination

Law of fall, no backward influence on data of sense

Mathematical circle of higher viewpoints: system, symbolism, new rule

Scientific circle: insight hypothesis process of observation and
 experimentation new data revise insight

Classical Heuristic Structure

Scissors action

Heur Struct
 From above downwards
 From below upwards
 Data

Illustration from algebra

give unknown a name, x

draw a diagram,

flag the diagram

write out an equation

 $(x = x/12 \mp 15)$

solve the equation

Science

give it a name, what will be known when understood, "nature of..."
 nature of... a universal, similarst similarly understood

virtus dorm

similarities for us: same color shape sound -- description

similarities of things in their relations to one another -- explana

nature of... replaced by unspecified correlation to be specified
by undetermined function to be determined

Galileo - correlation of distance and time
Mathematization of nature (Burtt p 154)
differential equations

math: let number be x

phys: let function be $f(x, y, z, t) = 0$

math: general relationship: minute hand x , hour hand $x/12$

phys: differential equation (of which solutions include relevant $f()$)

math: diagram whence equation to be solved

phys: boundary conditions, select btwn possible solutions of diff eq

classical heuristic structure

supposes data

mathematization of data by measurement

insight that yields correlation of measurements

implications of correlations

verification of implications

consists in reflection on process

~~XXXXXXXXXXXXXXXXXXXX~~

insight into process

expression of insight as a structure (sequence of steps)

classical: results of type of Galileo Newton Maxwell Einstein

no implication of any view or opinion about corpuscles waves

causality mechanism determinism uniformity-of-nature objectivity

appearance reality --- what are you doing when inquiry is empirical
classical

Concrete Inferences from Classical Laws

Newton: God the clockmaker; had to rewind it periodically

Laplace: no need, planetary motions periodic, on supposition
of small eccentricity (ellipse nearly circular)

of Britannica, art. Laplace

assumption of mechanist determinism

Classical laws are abstract; hold other things being equal

sun could burn out

other large bodies could invade solar system

other things are equal as long as scheme of recurrence holds

Eddington's
Two tables
Only one
legitimate
image

Things for us: as related to our senses, as imaginable
things themselves: as related to one another, correlations of
measurements; not necessarily related to our senses, to
our imagination; the non-imaginable; all we can say is
what we express mathematically

Concrete inferences from classical laws pp 46-53, 86-102

1) suppose return from abstract to concrete

abstract from empirical residue, places times, individuals
 abstract from non essential incidental, irrelevant insignificant
 verified correlations, what is correlated is defined implicitly
 by the correlation: mass is what is designated by 'm' in
 verified equations or definitions

Eddington's two tables; things for us, ie in relation to
 our senses, color shape feel resistance odor, can be imagined;
 things in their relations to one another; data measurement
 correlations of measurements higher systems of correlations;
 relation to our senses, to our imaginations vanish

two viewpoints on the same table; only one of them imaginable

2) return from classical laws to concrete situations means

return to imaginable places times configurations distributions
 of energy

on such a return two cases arise

3) the spatial and temporal configuration and a distribution is such that in virtue of known laws that same configuration and distribution will be recurrent

because recurrence and recurrence understood in terms of
 laws, deduction possible indefinitely (caeteris paribus)

Newton, God clockmaker had to rewind clock periodically

Laplace as long as eccentricities of planets small, periodic

verified: moon:: phases tides putting man on moon eclipses

orbits of planets: map of sky

sunrise and sunset; exact time predicted for any point on
 earth's surface

reversible; can calculate past or future equally well on
 basis of same principles data

4) all such prediction supposes "caeteris paribus"

another large body could come within our planetary system
 and all tables would have to be revised

alternative possibility: if A then B provided G H I occur
 and U V W do not occur; there are as many positive and
 negative conditions for each of G H I... and for each of U V W...
 etc to yield a diverging series of conditions, scattered in
 space and varying in times, so that depends on coincidental manifold

5) whence comes the difference

scheme of recurrence adds further insight into sensible data such that combination of laws imply recurrence of initial situation

diverging series of conditions admits that coincidental manifold of fulfilled conditions will imply that B follows from A -- but it does not imply the recurrence of the coincidental manifold of fulfilled conditions

6) break at pool

position of each of sixteen balls after break can be deduced if momentum of cur ball known accurately, precise point of contact with triangle of 15 balls known accurately, precise initial pressure of each of fifteen balls on those next it known accurately, friction of cloth and elasticity of bands known accurately

still no general formula; in each case one has to work out in which direction each of sixteen balls will move after impact, which will collide, what will be their subsequent trajectories, etc.

having worked the thing out for one case, slight differences in initial momentum etc easily imply widely varying results

process is not reversible: humpty dumptly goes to pices when he falls; but the break up has no tendency to reconstitute the initial situation

Statistical heuristic structure

classical seeks immanent intelligibility of process

what is nature of free fall: a constant acceleration

what is the law of the level: $af' = bf''$

statistical asks how many? how often?

actual frequency: events have occurred and been counted

ideal frequency: approximate anticipation, probability

absolute actual frequency: so many in such an area during period

rate: so many per thousand, compares different areas periods

relative actual frequency: different events, PQR, are alternative

possibilities, $p/n, q/n, r/n$... where $n = p + q + r + \dots$

Probability: a priori notion, equiprobability

$6/36, 5/36, 4/36, 3/36, 2/36, 1/36$

7 6 or 8 5 or 9 4 or 10 3 or 11 2 or 12

Probability: a posteriori, empirical,

consider set of relative actual frequencies

$p_i/n_i, q_i/n_i, r_i/n_i, \dots$ where $n_i = p_i + q_i + r_i + \dots$ $i = 1, 2, 3, \dots$

then probabilities will be $p/n, q/n, r/n$

if the differences $p/n - p_i/n_i$ are random

random: no assignable law; no trend one way or other

Concidental manifold of processes gives merely coincidental

manifold of results; and coincidental manifold of results

will not exhibit a trend (inverse insight)

Axiomatization of mathematical probability: Komolgorov

Classical treatise, Feller,

See Brittanica or other encyclopedia

Patrick Heelan, Quantum Mechanics and Objectivity, A Study

of the Physical Philosophy of Werner Heisenberg, The Hague:

Martinus Nijhoff, 1965

State: defined by set of probabilities, actual relative frequencies

Change of state: change of probabilities

Trend: orderly sequence of change of probabilities

Comparison of classical and statistical heuristic structures

see pp. 63-66

Canons of empirical Method

Selection: only questions that can be resolved by appeal to sensible consequences

1.1 What about data of consciousness

1.2 What are sensible data (senses and orientation of consciousness)
 Paul Actemeier, An Introduction to the New Hermeneutic,
 Philadelphia 1969 perception

Operations, principle of

cumulative expansion: laws guide operations, new data, new discover
 cumulative verification
 systematization: to do things, combine diverse laws
 higher viewpoints

Relevance

end, agent, tools, materials: all real; all relevant to applied sc
 but science is pure when it discovers what there is to be applied
 immanent intelligibility of process
 Galileo, free fall; Kepler, laws of planetary motion, Newton G
 things as related to our senses :: EXPERIENTIAL CONJUGATES
 things as related to one another: measurement correlation higher
 system :: EXPLANATORY CONJUGATES
 Eddington's two tables: only one legitimate image

Parsimony

affirm no more than you verify
 what is verified is the correlation, what is implicit in
 the correlation, eg mass defined implicitly by equations
 containing the symbol "m": ~~XXXXXXXXXXXX~~
 what do you mean by event

Complete Explanation

Science aims at the complete explanation of all phenomena
 Extensions durations motions as perceived; experiential conjugates
 As explained in 4-dimensional manifold
 contrast Galileo's primary secondary qualities; Newton's
 absolute space and absolute time; Kant's a priori forms of
 sensibility

The Complementarity of Classical and Statistical Investigations

Concrete situation

is periodic: if situation A exists, it will recur

recurrence follows from some combination of classical laws

recurrence is conditioned: other things being equal
possible

Consider the set of/periodically recurring situations (PPRS)

eg ecology: can be disrupted

but has a probability of emergence under certain condi

has a probability of survival once conditions fulfilled

Consider conditioned sequence of PPRS

such that when one PPRS emerges, the probability of other PPRS jumps

With sufficiently large numbers and sufficiently long intervals
of time, even minimal probability implies eventual occurrence

Insight pp 259 ff. : Things and Emergent Probability